Fritillaria arafoera n. sp., a Form of the Sibling Species: *Fritillaria haplostoma*–Complex (Appendicularia: Chordata)

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AN APPENDICULARIAN specimen found in one of the plankton samples hauled by Mr. Sagara in the Arafura Sea during the biological survey of the pearl oyster fishery ground seems to represent a new species, which is described here and named *Fritillaria arafoera*. The species is considered to show an extreme form of the sibling species forming the *Fritillaria haplostoma*–complex, in which *F. abjornseni* Lohmann and many of Essenberg's species are included. The latter are discussed taxonomically in the last part of the article.

Fritillaria arafoera n. sp.

TRUNK: This is a small species. Trunk is 440 μ in length and quite wide, being widest on the level of the posterior part of the oikoplast-epithelium and with the value of width/length about 0.4. The body is slightly bent ventrad at the insertion point of the tail, situated slightly posterior to the middle of the body. It is rather compressed dorsoventrally excepting the anterior one third of the trunk, where a remarkable hood is formed on the oikoplast-epithelium, the posterior margin of which almost reaches the anterior end of the stomach. The anterior half of the pharynx is fairly narrow, the upper lip is roughly triangular in outline and protruded anteriorly beyond the frontal end of the hood. Endostyle short, curved only slightly; a ciliated band encircles the buccal cavity on the level of the anterior end of the endostyle. Spiracles comparatively large, roundish in outline and well separated. Oesophagus short, stomach globular and with nearly smooth surface. Intestine with three glandular appendages (gl. ap. 1–3, Fig. 1) arranged dorsoventrally, the middle one (gl. ap. 2, Fig. 1) much larger than the other two. This middle appendage assumes superficially a glandular appearance and it is treated here as a glandular appendage. However, it is possible that this is merely a part of the intestine proper. Ovary is spherical and testis is an elongate mass, genital region of the trunk is much shorter than the rest. Gland cells are distributed as follows: one at the posterior end of the testis, one at each posterolateral corner of the trunk, one at the outer side of each spiracle and one near each posterolateral edge of the hood.

TAIL: Tail is 1380 μ in length. Tail length/trunk length is 3.1. The proximal end of the tail fin assumes an appearance of sloping shoulders instead of angular shoulders frequently met with in common fritillarians. Musculature wide, but distally diminishing in breadth rather rapidly. Thus it is narrowed nearly to the breadth of the chorda in the posterior part, although it definitely reaches the distal end of the chorda. Width of tail musculature/tail length ($\times$100) is 11.8 and width of chorda/maximum width of tail musculature ($\times$100) is 17. The distal end of the tail fin is fringed with slightly thickened margin, this probably indicates the existence of cilia at this portion.

REMARKS

The present new species resembles most closely *Fritillaria abjornseni* Lohmann from the neighbouring waters of Fremantle and *Fritillaria lohmanni* Essenberg and *F. tereta* Essenberg from the San Diego region in smaller size of body and general appearance

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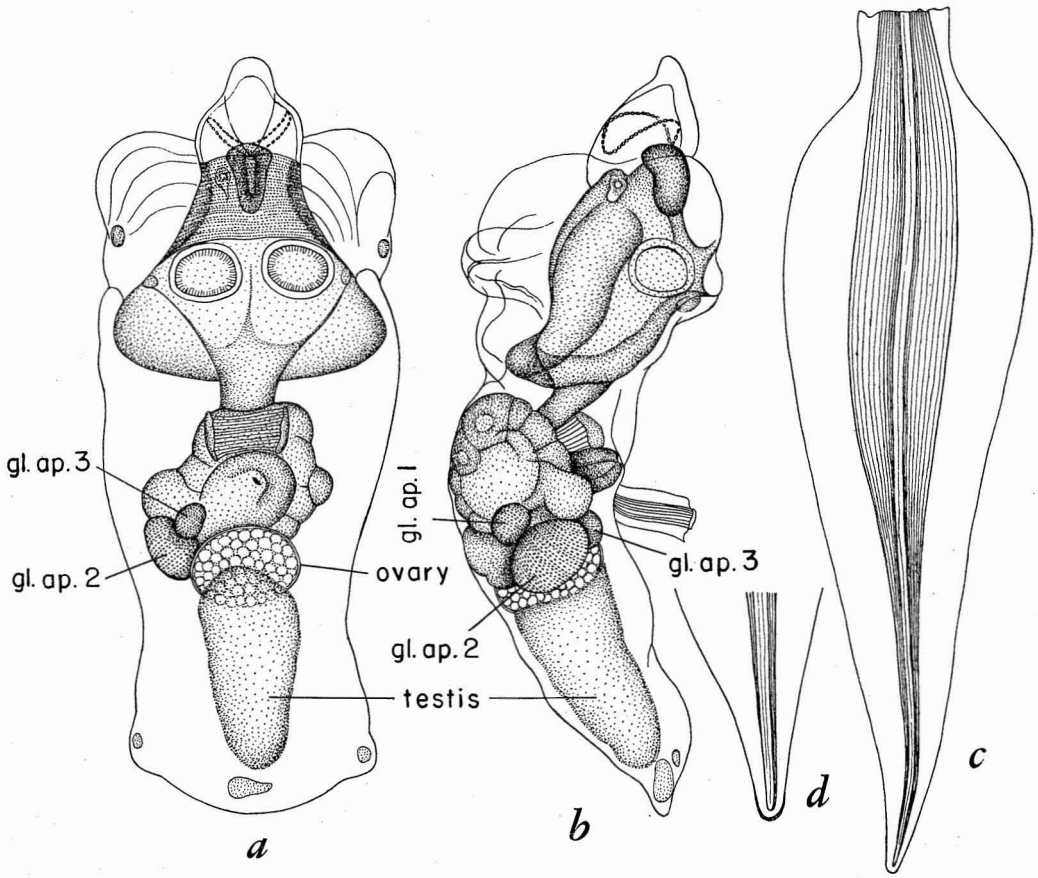

FIG. 1. *Fritillaria arafoera* n. sp.: *a*, Ventral aspect of trunk, ×200; *b*, right lateral aspect of trunk, ×200; *c*, tail, ×73; *d*, distal portion of tail, ×200. gl. ap.—glandular appendage.

of both trunk and tail. It is especially related to *F. lohmanni* in that three glandular appendages are found on the intestine. In *F. arafoera*, however, the middle one of the three accessory blind sacs (=glandular appendages) may possibly represent a part of the intestine proper. In both of Essenberg's species, moreover, the trunk is much more elongate than in the present one and the distance between the posterior margin of the oikoplast-epithelium and the anterior edge of the stomach is much greater than in the Arafuran specimen. Thus, *F. abjornseni*, *F. lohmanni*, and *F. tereta* conform well to one another in that both spiracles are in contact with each other at the inner side, and this feature is considered by Lohmann (1909) as the critical characteristic of *Frit. abjornseni*. Consequently these three species are considered to be treated as forms belonging to a single species, the name of which should be *Fritillaria abjornseni* according to the law of priority. In the present species, however, the two spiracles do not touch as shown in Figure 1A. For these reasons, I prefer at present to treat the present specimen as a new species and name it *Fritillaria arafoera*.

As I stated previously (Tokioka, 1951: 4), *F. haplostoma* shows a considerable range of variation in body length. Small specimens of *F. haplostoma* described in an earlier paper (Tokioka, 1955: 259), smaller forms reported

in the same paper (p. 256) under the name of *F. abjornseni* and several forms allied to *F. haplostoma*, described by Essenberg (1926) under different names, seem to combine *F. abjornseni* with typical forms of *F. haplostoma* as far as body size is concerned.

Considering the structure of the trunk, the shape of the spiracles seems not to be accepted as an important characteristic, because it varies from elongate to round, correlated with decrease of body size. Even in large specimens, the spiracles may sometimes be roundish as they are indicated in the original figure by Fol (1872, pl. VI, fig. 6). The distance between the posterior end of the oikoplast-epithelium and the frontal edge of the stomach seems to diminish regularly according to the shortening of the trunk. The surface of the stomach may be considerably roughened by protrusion of some wall cells in some individuals although it is usually smooth in smaller specimens. The proportional length of the genital region diminishes with the decrease of the body length.

The tail of typical *F. haplostoma* is characterized by narrow musculature and exposed posterior portion of the chorda. The musculature scarcely reaches beyond the lateral sides of the chorda in typical forms, but in some individuals, especially in smaller ones, it is slightly wider than the chorda. In *F. abjornseni* Lohmann (1909), C/M × 100 measured on his figure is 22.2, while it is 16.6 in *F. tereta* and 20.8 in *F. lohmanni* both also measured on figures. In specimens reported by Tokioka (1955) under the name of *F. abjornseni*, the value is about 33. It is 36.4 in *F. lucibila* Essenberg and about 50 in *F. limpida* Essenberg. These data seem to support the idea that the narrow tail musculature of typical *F. haplostoma* continues to the wider tail musculature of *F. abjornseni* through several intermediate forms. The exposed posterior portion of chorda is fairly long in typical forms of *F. haplostoma*, but it is extremely short in forms described by Tokioka (1955) under the name of *F. abjornseni*. Unfortunately, as no description is given about this feature on the type specimen of *F. abjornseni* and many forms reported by Essenberg, further consideration of this characteristic must be abandoned.

According to Lohmann (1909) the most important characteristics differentiating *F. ab-*

TABLE 1

TEN FORMS OF THE *Fritillaria haplostoma* COMPLEX GROUPED BY DIFFERENCES IN THREE CHARACTERISTICS
(Values of width of chorda and maximum width of tail musculature in species of Lohmann and Essenberg were measured on published figures)

NAME OF SPECIES	LENGTH OF TRUNK	WIDTH OF TRUNK / LENGTH OF TRUNK	CHORDA / MUSCLE × 100
Group I			
Fritillaria lucibila Essenberg	850 μ	0.16	36.4
Fritillaria limpida Essenberg	700	0.2	50
Group II			
Fritillaria campila Essenberg	550	0.2	31.8
Fritillaria tacita Essenberg	500	0.2	26
Fritillaria abjornseni (described by Tokioka in 1955)	440–740	0.25	33
Group III			
Fritillaria amygdala Essenberg	340	0.33	22.7
Fritillaria lohmanni Essenberg	370	0.16	20.8
Fritillaria tereta Essenberg	400	0.25	16.6
Fritillaria abjornseni Lohmann	250	?	22.2
Group IV			
Fritillaria arafoera n. sp.	440	0.4	17

jornseni from *F. haplostoma* are the smaller size, the spiracles touching each other at the inner side and the tail musculature being much wider than the chorda. In Table 1 I attempt to arrange various allied forms of *F. haplostoma* and *F. abjornseni* systematically on these standards.

Group I may safely be accepted as proper *F. haplostoma*, because the tail musculature is rather narrow and the spiracles are comparatively small and situated apart from each other. The four forms of Group III are undoubtedly united into a single species, *F. abjornseni*, because the tail musculature is very wide and both spiracles touch each other at the inner side. Group II is considered to involve intermediate forms between Groups I and III in the feature of the tail musculature. The spiracles are separated from each other, but they are comparatively large as in Group III, except in *F. tacita*. The exposed posterior portion of the chorda is extremely short in the last member of the group as compared with that in the typical form of *F. haplostoma*, and the distance between the posterior end of the oikoplast-epithelium and the frontal edge of the stomach is very slight in the last two of the group. For these reasons, I prefer to treat this group conveniently under *F. abjornseni*, by extending the definition of this species so as to include forms which have spiracles separated from each other. *F. arafoera* is characterized by a remarkably wide trunk, separated spiracles, wide tail musculature, basal part of the tail fin like sloping shoulders and absence of the exposed distal portion of the chorda, although it is closely related to *F. abjornseni*.

I am here placing the ten forms considered in the table into three species: *F. haplostoma*, *abjornseni* and *arafoera*. And it seems very reasonable to consider these three species as sibling species forming a *Fritillaria haplostoma*-complex, in which *F. magna* Lohmann and *F. aberrans* Lohmann may also be included when more abundant data concerning the feature of the alimentary organ are accumulated and considered carefully. However, the mechanism which causes this wide variation is still unknown. It is clear that both *F. abjornseni* and *F. arafoera* are found mostly in coastal waters and smaller forms of *F. haplostoma* are met with more frequently in coastal water rather than in the pure oceanic water. Lastly, the present new species certainly may be considered as being situated at the extremity of a wide range of variation, opposite to the typical *F. haplostoma*.

I wish to express here my hearty thanks to Mr. Sagara for his kindness in giving me a chance to examine the present precious material.

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